UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant:	Kirk Charles Frederickson
Serial No.:	10/676,775
Filed:	October 1, 2003
Group Art Unit:	3682
Examiner:	Van Pelt, Bradley J.
Title:	HARMONIC FORCE GENERATOR FOR AN ACTIVE VIBRATION CONTROL SYSTEM

Commissioner for Patents
Mail Stop Appeal Brief-Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Dear Sir:

Appellant submits this Appeal Brief pursuant to the Notice of Appeal filed October 13, 2006.

REAL PARTY IN INTEREST

The real party in interest is **Sikorsky Aircraft Corporation**, assignee of the present invention.

RELATED APPEALS AND INTERFERENCES

There are no prior or pending appeals, interferences or judicial proceedings which may directly affect or may be directly affected by or have a bearing on the Board's decision in this appeal.

STATUS OF CLAIMS

Claims 1, 2, 4, 5, 7, 23 and 24 stand pending, rejected and appealed.

Claims 8, 9, 13, 19 and 27-30 stand withdrawn from consideration.

STATUS OF AMENDMENTS

All amendments have been entered.

SUMMARY OF CLAIMED SUBJECT MATTER

The dominant source of vibration in a helicopter is that generated by the main rotor system at the blade passing frequency (rotation rate times the number of rotor blades). Forces and moments are transmitted usually through the transmission via fuselage attachments, to produce vibration in the fuselage. [¶2]

One conventional approach to reducing such vibration involves replacing a rigid gearbox mounting strut with a compliant strut and parallel hydraulic actuator. Another conventional approach utilizes force generators consisting of counter-rotating eccentric masses that rotate at the frequency of the primary aircraft vibration and generate a fixed magnitude vibration force. This system, although effective for direct gearbox mounting, requires a parasitic mass of considerable magnitude which may result in an unacceptable weight penalty. [¶¶3-4]

The present application relates to producing large, controllable, vibratory forces to compensate for sensed noise or vibrations, and more particularly to a force generator which is part of an active vibration control (AVC) system for an aircraft. [¶1]

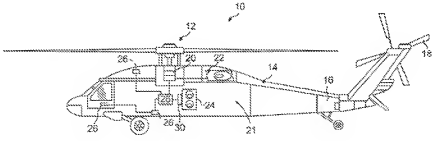


Figure 1 schematically illustrates an aircraft 10 having a main rotor assembly 12. The aircraft 10 includes a fuselage 14 having an extending tail 16 which mounts an anti-torque rotor 18. The main rotor assembly 12 is driven through a transmission (illustrated schematically at 20) by one or more engines 22. Vibrations from the rotating main rotor assembly 12,

transmission 20, and the engines 22 are thus transmitted to the helicopter fuselage 14. This vibration transmission is particularly manifest in rigid gearbox mounted systems. [¶¶24-25]

One or more force generators 24 are mounted within the fuselage 14, however, there are numerous locations within the aircraft 10 for locating the force generators 24. A plurality of sensors 26 are mounted at various locations and communicate with a processor 28. The sensors 26 are preferably mounted in the cockpit or cabin areas adjacent to crew or passenger stations. The sensors 26 are preferably accelerometers which generate signals representative of dynamic changes at selected locations as the main rotor assembly 12 rotates. The processor 28 generates output signals to operate a power source 30 such as an electric motor, air motor, hydraulic motor, turbine or the like. The power source 30 operates to control the phase and magnitude characteristics of the force generator(s) 24 in response to the processor 28. [¶26]

In operation, vibratory forces are produced by the main rotor assembly 12 due, for example, to asymmetric air flow in forward flight. Such vibratory forces arising as the main rotor assembly 12 rotates are, in the absence of any compensating systems, transmitted from the rotor 12 to the fuselage 14. Operation of the force generator(s) 24 is continuously varied by the processor 28 to cater to changing dynamic characteristics such that vibratory forces caused by the rotor assembly 12 and/or other vibratory sources are reduced or eliminated. [¶27]

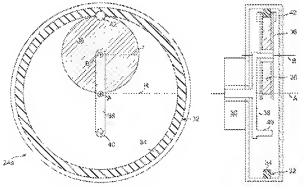


FIG. 2A FIG. 2B

Referring to Figure 2A, a force generator 24a is illustrated. A first circular member 32 is defined about a first axis of rotation A to define a first inner diameter 34 and a first radius R. The first circular member 32 is preferably a ring gear with the ring gear pitch circle as the first inner diameter 34. [¶28]

A second circular member 36 is defined about a second axis B to define a second radius r. The second radius r is one-half the first radius R. The second circular member 36 is preferably a planet gear engaged with the first circular member 32. The second circular member 36 is movable to simultaneously complete one revolution about the second axis B and one orbit around the first axis A. [¶29]

A crank 38 (also illustrated in Figure 2B) mounts the second circular member 36. The crank 38 rotates about the first axis A and supports a counterweight 40. The crank 38 is rotated by the power source 30 (Figure 2B). The counter weight counters the weight of the second circular member 36. A mass 42 is located at a circumference of the second circular member 34 to generate a vibratory inertial force as the second circular member 36 simultaneously complete one revolution about the second axis B and one orbit around the first axis A to define a two cusp hypocycloid (the geometric principal can be understood by referring to Figure 3 where the inner circle is shown in several positions). [¶30]

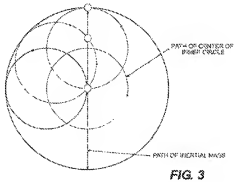


FIG. 3

Referring to Figure 4, the operation of the force generator 24a is formulaically illustrated.

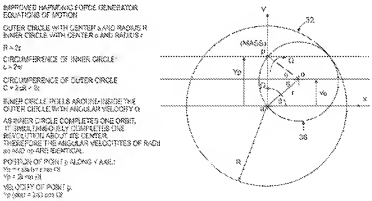
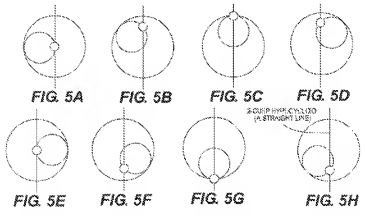


FIG. 4

The first circular member 32 has center a and radius R while the second circular member 36 has center o and radius r. Generally, a point such as mass 42 on the circumference of a circle rolling inside another circle traces hypocycloids. If the second circular member 36 diameter is exactly one half of the second circular member 32 diameter, a point on the circumference of the second circular member 36 creates a two cusp hypocycloid which is a straight line. If the second circular member 36 moves with constant angular velocity, the point on the circumference moves with a simple harmonic motion. The mass 42 which is located at point p on the circumference will therefore generate a sinusoidal inertial force in a straight line (further illustrated in Figures 5a-5h). [¶¶31-48]



Such a smooth sinusoidal vibratory force output is particularly suitable for the compensation of main rotor rotation vibrations. [¶48]

Summary of Claim 1

Claim 1 recites:

1. A force generator comprising:

a rotationally fixed first circular member defined about a first axis to define a first inner diameter circular path, said first circular member having a first radius;

a second circular member defined about a second axis offset from said first axis to define a second radius, said second radius one-half the radius of said first radius, said second circular member movable about the circular path to simultaneously complete one revolution about said second axis and one orbit around said first axis;

a crank which mounts said second circular member, said crank rotatable about said first axis; and

a mass located at adjacent a circumference of said second circular member movable about a two-cusp hypocycloid path to generate a vibratory inertial force, to minimize a vibratory force.

Thus, referring in particular to Figures 2A and 2B, claim 1 recites a ***rotationally fixed*** first circular member 32 defined about a first axis A to define a first inner diameter circular path, the first circular member having a first radius R. As recited in the specification, the first circular member 32 is preferably a ring gear with the ring gear pitch circle as the first inner diameter 34. Claim 1 further recites a second circular member 36 defined about a second axis B offset from the first axis A to define a second radius r, the second radius r one-half the radius of the first radius R, the second circular member 36 ***movable about the circular path to simultaneously complete one revolution about said second axis and one orbit around said first axis***. As recited in the specification, the second circular member 36 is preferably a planet gear engaged with the first circular member 32 such that the second circular member 36 is movable to simultaneously complete one revolution about the second axis B and one orbit around the first axis A. Nothing within the claim suggests that the first circular member is anything but rotationally fixed in position.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 2, 4, 5, 7, 23, and 24 were finally rejected under 35 U.S.C. §112, first paragraph.

Claims 1, 2, 4, 5, 7, 23, and 24 were finally rejected under 35 U.S.C. §112, second paragraph.

Claims 1, 2, 4, 5, 7, 23, and 24 were rejected under 35 U.S.C. §102(b) as being anticipated by *Kanski* (2309172).

ARGUMENT

§112 REJECTIONS

Claims 1, 2, 4, 5, 7, 23, and 24 were finally rejected under 35 U.S.C. §112, first paragraph. The Examiner argues that the phrase "rotationally fixed" raises a new matter issue since such description is not supported by the original specification or the drawings as filed. Appellant respectfully disagrees.

Figure 2B, as well as each of the other sectional views, illustrates the rotationally fixed member (first circular member 32) mounted to a housing (shaded; not numbered). A power source 30 is mounted to the housing to rotate the second circular member 36 through a crank 38.

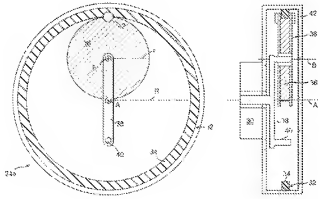


FIG. 2A FIG. 2B

Notably, the rotationally fixed first circular member 32 is mounted directly to the housing with no indication of a component such as a bearing which would permit rotation relative to the housing. In other words, the housing supports both the first circular member 32 and the power

source 30 such that the crank and the supported second circular member 36 may be rotated relative thereto as schematically depicted in Figure 3.

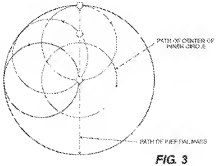


FIG. 3

Figure 3 in particular, but also Figures 4 and 5A-5H schematically illustrate the motion of Appellant's invention. None of these figures give any indication whatsoever that the "rotationally fixed" first circular member 32 is anything but. That is, with particular reference to Figure 3, arrows are utilized to show movement of the movable members such that a proper interpretation of a lack of arrows is that the first circular member 32 is "rotationally fixed" as utilized in Appellant's claims. From the figures alone, but especially in combination with Appellant's specification and claims, Appellant respectfully submits that the phrase "rotationally fixed" is properly supported and cannot properly be considered new matter. Appellant respectfully requests that the final rejection be overturned.

It should be further noted that, if anything, the claims are more narrow than the specification if the Examiner's interpretations were to control. That is, at best, the Examiner is only arguing that the first circular member 32 may rotate or be stationary. Thus, even under the Examiner's improper interpretation can no way be considered "new matter." The rejection is improper.

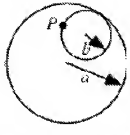
Claims 1, 2, 4, 5, 7, 23, and 24 were finally rejected under 35 U.S.C. §112, second paragraph. The Examiner suggests that the phrase "rotationally fixed" is indefinite because it is not clear what is meant by "rotationally fixed." The Examiner states in the July 14, 2006 Office Action at page 6:

6. Claims 1, 2, 4, 5, 7, 23, and 24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

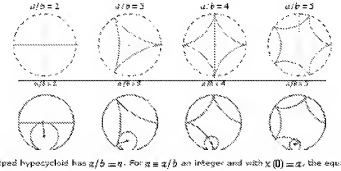
Claim 1 recites the newly included phrase "rotationally fixed" in line 2. It is indefinite because it is not clear what it means by "rotationally fixed" Is the first circular member fixed and rotational? Or, is the first circular member not moving at all (and if so, in relative to what element)?

(Note: for the purpose of complete examination of the application, the phrase "rotationally fixed" has been construed as being rotatable and fixed to the axis A.)

Initially, Appellant's usage of the phrase "rotationally fixed" is definite as a claimed two-cusp hypocycloid path would be unachievable were the first circular member not "rotationally fixed." That is, a two-cusp hypocycloid path is defined as:



The curve produced by fixed point P on the circumference of a small circle of radius b rolling around the inside of a large circle of radius $a > b$. A hypocycloid is therefore a hypotrochoid with $h = b$.



An n-cusped hypocycloid has $a/b = n$. For $n \equiv a/b$ an integer and with $x(0) = a$, the equations of the hypocycloid therefore become

$$x = \frac{a}{n}\left[(n-1)\cos\phi - \cos\left[(n-1)\phi\right]\right] \tag{12}$$

$$y = \frac{a}{n}\left[(n-1)\sin\phi + \sin\left[(n-1)\phi\right]\right] \tag{13}$$

and the arc length and area are therefore

$$s_2 = 8b(n-1) = \frac{8a(n-1)}{n} \quad (14)$$

$$A_n = \frac{(n-1)(n-2)}{n^2}\pi a^2. \quad (15)$$

A 2-cusped hypocycloid is a line segment (Steinhaus 1999, p. 145; Kanas 2003), as can be seen by setting $a=2b$ in equations (*) and (*) and noting that the equations simplify to

$$x = a\sin\phi \quad (16)$$

$$y = 0. \quad (17)$$

http://mathworld.wolfram.com/Hypocycloid.html

That is, were the Examiner's interpretation to control, Appellant could not even achieve the explicitly claimed two-cusp hypocycloid path. For this reason alone, Appellant's rejected claims are definite.

Furthermore, the claims specifically recite a crank which mounts said second circular member, said crank rotatable about said first axis and a rotationally fixed first circular member defined about the first axis such that the claim is definite with regard to the rotationally fixed first circular member being "rotationally fixed" relative to the first axis. Appellant respectfully submits that the claim language on its face is definite and properly allowable.

Appellant would like to further note that even the Examiner specifically admits in the Response to Argument section of the July 14, 2006 office action, that liberty has been taken so as to construe the meaning of the phrase in question to mean "rotatable and fixed to the axis." Appellant submits that such *liberty taking* is improper. In fact, the Examiner's interpretation of the phrase "rotationally fixed" as being "rotatable and fixed to the axis A" is itself internally inconsistent and in opposition to the plain meaning of Appellant's claim language which specifically recites: a **rotationally fixed** first circular member defined **about** the first axis.

The Examiner's parsing of Appellant's claim language is improper. Under no proper interpretation can Appellant's claim language be construed as "rotatable about." Appellant respectfully submits that by properly interpreting the phrase "rotationally fixed," not only are the 35 U.S.C. §112 rejections overcome, but that the 35 U.S.C. §102(b) rejections over *Kanski* are also properly overcome due to the Examiner's own admission.

§102 REJECTIONS

Claims 1, 2, 4, 5, 7, 23, and 24 were rejected under 35 U.S.C. §102(b) as being anticipated by *Kanski* (2309172).

As admitted by the Examiner in the July 14, 2006 Office Action at page 3, *Kanski* discloses a ***rotatable*** first circular member that is fixed to an axis of rotation, it does not disclose, teach or suggest a rotationally fixed first circular member as claimed by Appellant. *Kanski* cannot meet the limitation of a rotationally fixed first circular member. Thus, should the 35 USC §112 rejections be overcome, the claims ***are properly allowable over Kanski by the Examiner's own admission***.

As discussed above, Appellant respectfully notes that by properly interpreting the term "rotationally fixed," this case is in condition for allowance.

CONCLUSION

For the above reasons, the rejections by the Examiner should be reversed.

The Commissioner is authorized to charge $500 for the appeal brief filing fee to Deposit Account No. 19-2189.

Also, the Commissioner is authorized to charge $120 for a one-month extension of time to Deposit Account No. 50-1482, in the name of Carlson Gaskey & Olds PC.

Respectfully Submitted,

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Dated: January 8, 2007

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CLAIMS APPENDIX

1. A force generator comprising:

a rotationally fixed first circular member defined about a first axis to define a first inner diameter circular path, said first circular member having a first radius;

a second circular member defined about a second axis offset from said first axis to define a second radius, said second radius one-half the radius of said first radius, said second circular member movable about the circular path to simultaneously complete one revolution about said second axis and one orbit around said first axis;

a crank which mounts said second circular member, said crank rotatable about said first axis; and

a mass located adjacent a circumference of said second circular member movable about a two-cusp hypocycloid path to generate a vibratory inertial force, to minimize a vibratory force.

2. The force generator as recited in claim 1, wherein said vibratory inertial force is a sinusoidal inertial force in a straight line.

4. The force generator as recited in claim 1, wherein said rotationally fixed first circular member comprises a ring gear.

5. The force generator as recited in claim 1, wherein said second circular member comprises a planet gear.

7. The force generator as recited in claim 1 , further comprising a motor which drives said crank.

23. The force generator as recited in claim 1, further comprising a motor which drives said crank.

24. The force generator as recited in claim 23, further comprising a controller which drives said motor to control said vibratory inertial force in response to a vibratory force from a main rotor assembly to minimize the vibratory force.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings.

RELATED EVIDENCE APPENDIX

None.